Space Weather Technical Forecast

Issued on Wednesday, 01 June 2022 at 13:22 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: Active Electron Fluence. Slight chance of R1/R2 Radio Blackouts.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Very Low, with no significant activity. There are five regions on the Earth-facing disc, four of which have been numbered. The most notable is AR3026 Dai/Beta which has rapidly grown in the last 12 hours, and was the source of a B8.6 flare at 01/1147 UTC, although this region currently remains relatively small and magnetically simple. AR3025 is now rotating off the disc, while the other regions are smaller, simple and mostly stable, although new Bxo/beta region developed in the southeast. No Earth-directed CMEs have been analysed in the last 24 hours, however a central disc filament eruption was observed to have an associated coronal dimming, and will likely be the source of a weak Earth-directed CME. This will be assessed once sufficient imagery is available.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1 has gradually declined from 550km/s to around 500km/s, before likely disconnecting from the recent coronal hole fast wind around 01/0640UTC, with a step down in speed to around 460-480 km/s. Density has been close to average, but also declined to below average around 01/0640 UTC. The interplanetary magnetic field strength, Bt, has been weak, below 6nT, with the north-south component, Bz, varying weakly between -5 and +4nT, but predominately in the negative direction. Phi angle was predominantly negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at background levels. The high energy electron flux (greater than 2 MeV) varied between moderate and high levels, reaching 5300 pfu at 31/1625 UTC. Electron fluence has been above the Active threshold reaching 1.5e8 integrated pfu at 01/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Very Low, with a chance of rising to Low and a slight chance of rising to Moderate, primarily due to the rapidly developing sunspot AR3026 in the northwest. This brings a slight chance of R1-R2 Radio blackouts.

Solar Wind / Geomagnetic Activity: A CME which left the Sun on the 23rd, whilst expected to miss, has a low chance of glancing across Earth on the 1st. There is also the chance of a weak Earth-directed CME from a filament eruption arriving towards the end of the period, however this needs further analysis. Otherwise currently slightly elevated to elevated solar winds are expected to gradually ease. Geomagnetic activity is forecast to be Quiet with a decreasing chance of isolated Unsettled spells, but a slight chance of Active intervals from any weak CME arrivals day 1 (1st) and towards the end of the period.

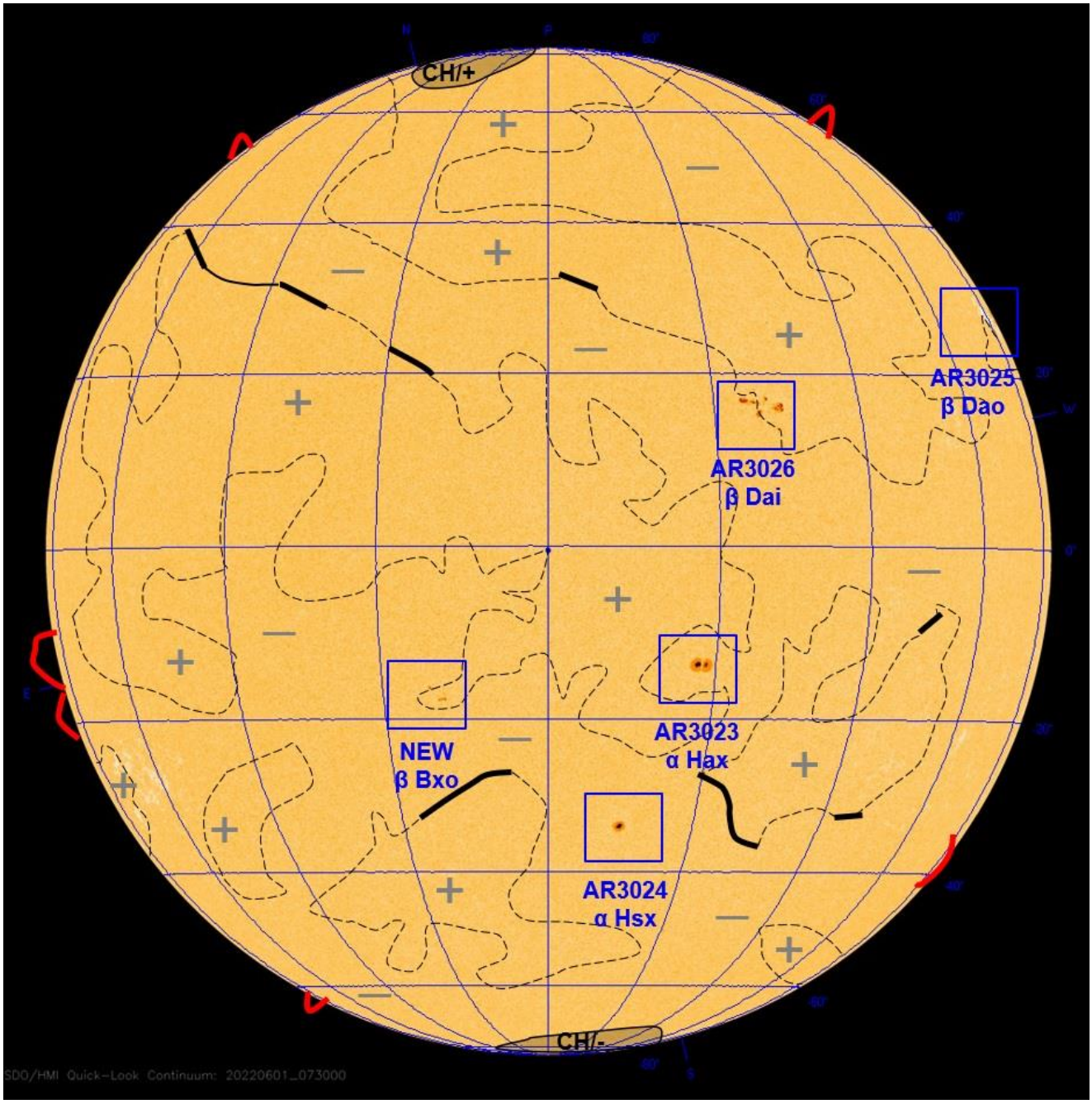
Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to be at background levels during this period. High energy electron flux (greater than 2MeV) is likely to continue at mainly High levels, with peak values only gradually easing later in the period. Electron fluence levels are expected to be Active throughout (1e8 integrated pfu), but

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

likely declining a little by the end of the period.

Figure 1. Solar Analysis Valid 01/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Geomagnetic Storms:

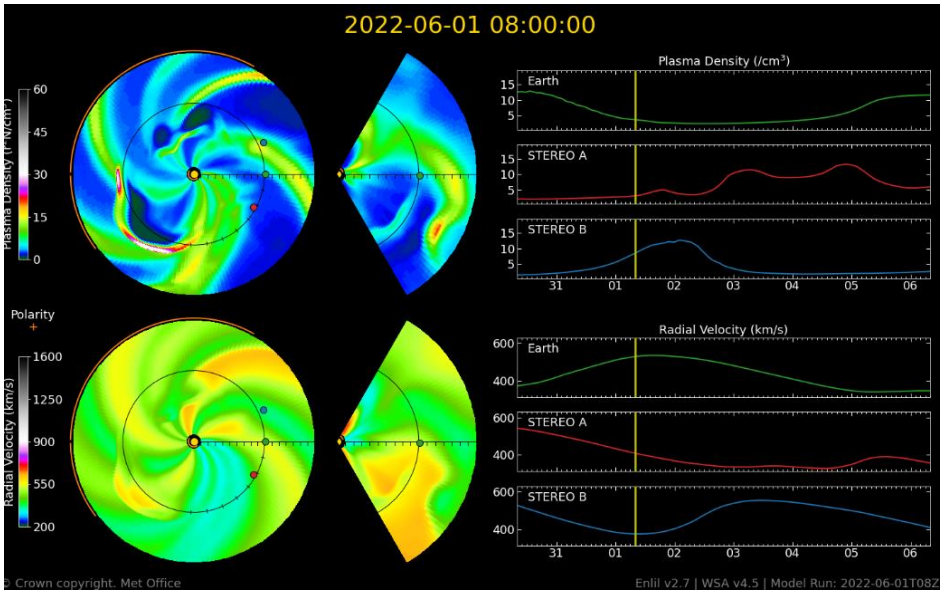
There are no Earth-directed CMEs currently expected to arrive, however a weak glance is possible from a CME that is expected to miss passing just behind and too the south of Earth's orbit on day 1 (1st). A filament lift-off was also observed from the centre disc around 01/0100 UTC, with an associated coronal dimming. A weak CME was likely produced however imagery is currently insufficient for any analysis of this feature, and any CME that did occur is likely to be weak and relatively slow.

Current elevated to slightly elevated solar winds are forecast to gradually ease through the period with no further notable enhancement expected. A weak coronal hole in the centre disc (CH86/-) is no longer identifiable, and hence any enhancement from this feature has been dropped from the forecast.

Geomagnetic activity is forecast to be mostly Quiet, with a slight chance of Unsettled intervals throughout, although a chance of increasing to Active on day 1(1st) and towards the end of the period from any weak CME arrivals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Enlil showing near-miss of CME from the 23rd (south of Earth).



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

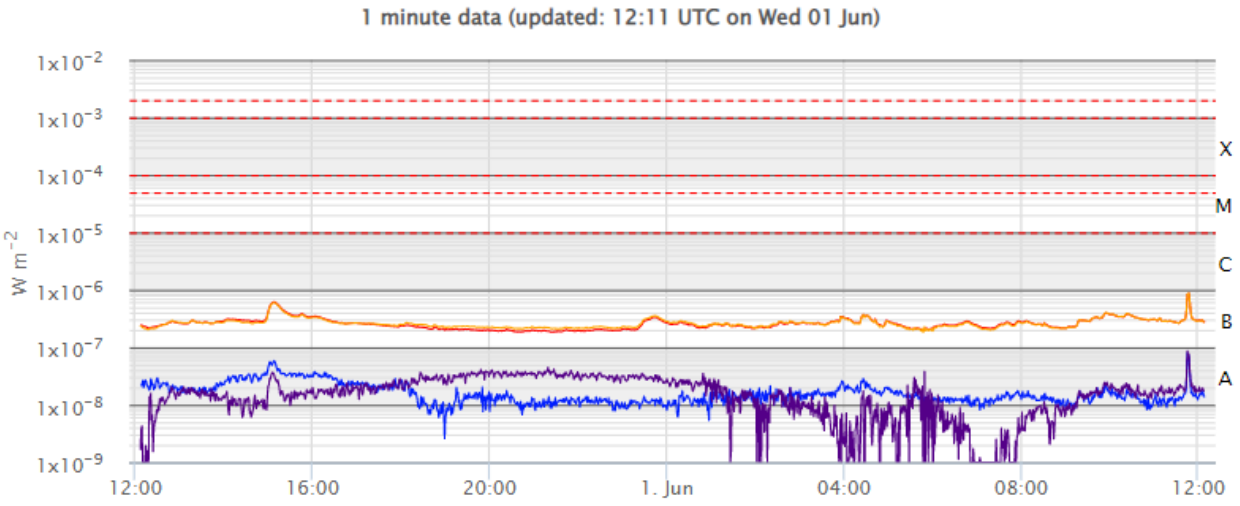
Radio Blackouts - X-Ray Flares:

There are four numbered regions on the disc, and one unnumbered region. Activity has remained Very Low for the last 24 hours, however the development of AR3026 Dai/Beta which has seen rapid growth in the last 12 hours increased the potential for flaring. However, this region remains small with a relatively straightforward magnetic structure. Slow growth has also been seen in the one unnumbered region in the southeast quadrant. Otherwise AR3024 Hsx/alpha and AR3023 Hax/alpha remain simple and stable regions, whilst AR3025 is now difficult to analyse as it rotates off the Earth-facing disc.

Overall activity is likely to be Very Low with a chance of rising to Low, with C-class flares, primarily from AR3023 and with a slight chance of rising to Moderate due to the low risk of M-flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	15	15	10	10
Very Active	R3 to R5 X Class	No	2	2	1	1

Figure 3: GOES-16/17 X-ray Flux



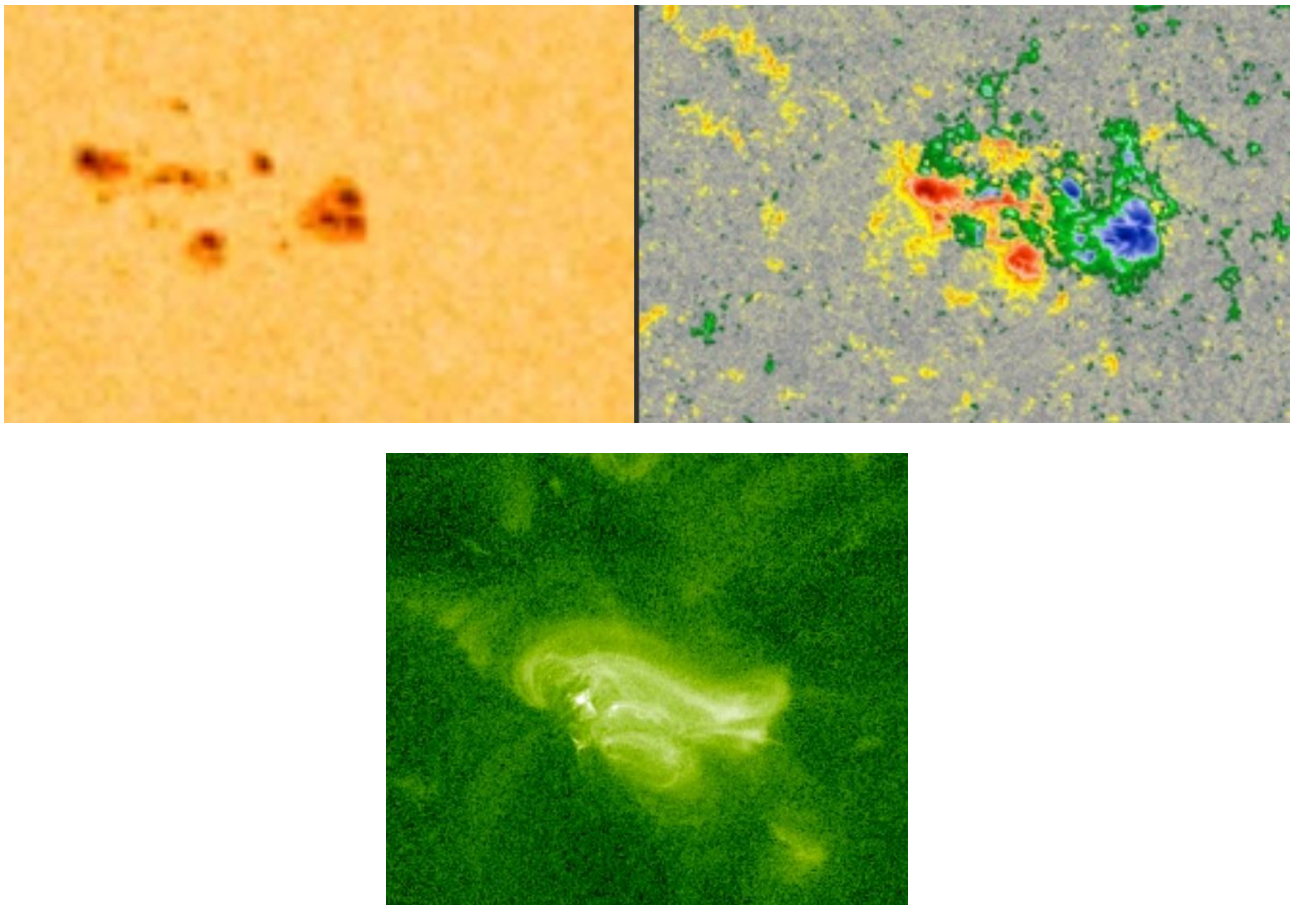
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10 MeV) is at background levels and is most likely to remain so through the period, with no significant regions on, or expected to rotate onto, the visible disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	2	2	2	2
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: SDO hmi-magnetogram and intensitygram of AR3026, with aia-94 below



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) as observed by GOES-16 has generally been at High (greater than 1000pfu) due to the recent fast wind enhancement. With no further notable disturbances forecast for the solar wind environment around Earth, these mainly High levels are expected to persist, although peak values are likely to decline gradually through the period with more prolonged periods of Moderate levels possible at the daily minimum.

The associated 24 hour electron fluence is currently Active (greater than 1e8) and expected to persist at this level through the period, but with a slightly increasing chance of falling below by day 4 (4th). This is supported by REFM for the initial 24 hours, however beyond this REFM is likely reducing values too quickly.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	100	100	80	70
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: GOES-16 Electron Flux (top) and associated 24-hr fluence (bottom, blue) with REFM (white) and Persistence (yellow)

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.